DOE/ID-10851
Revision 1
December 2001

U.S. Department of Energy
Idaho Operations Office

INEEL CERCLA Disposal Facility Construction Quality Assurance Plan for Phase 2 Construction (60% Design Component)

INEEL
Home of Science and Engineering Solutions
Idaho National Engineering and Environmental Laboratory

DOE/ID-10851
Revision 1

INEEL CERCLA Disposal Facility Construction Quality Assurance Plan for Phase 2 Construction (60% Design Component)

December 2001

Prepared for the
U.S. Department of Energy
Idaho Operations Office

ABSTRACT

This Construction Quality Assurance Plan describes the construction quality assurance responsibilities and procedures for work anticipated during Phase 2 construction for the INEEL CERCLA Disposal Facility. This shall include construction of the liner, leachate collection piping, and operation layer for cell 1 and the evaporation ponds. This Construction Quality Assurance Plan is prepared as a stand-alone document to be implemented by an independent, third-party Construction Quality Assurance certifying officer.

CONTENTS

TABLES

ACRONYMS

ARARs	applicable or relevant and appropriate requirements
ASTM	American Society for Testing and Materials
BBWI	Bechtel BWXT Idaho, LLC
CCI	CH2M HILL Constructors, Inc.
CCL	compacted clay liner
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CID	Construction Interface Document
CQA	construction quality assurance
CQC	construction quality control
DOE	U.S. Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
FFA/CO	Federal Facilities Agreement/Consent Order
GCL	geosynthetic clay liner
GRI	Geosynthetic Research Institute
HSO	health and safety officer
HWMA	Hazardous Waste Management Act
ICDF	INEEL CERCLA Disposal Facility
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LCRS	leachate collection recovery system

LDRS	leak detection recovery system
NCR	Non Conformance Report
NICET	National Institute for Certification in Engineering Technologies
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PM	project manager
QA	quality assurance
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RG	remedial guideline
STR	subcontract technical representative
TSCA	Toxic Substances Control Act
WAG	waste area group
WAG 3 PM	Waste Area Group 3 project manager
WRRTF	Water Reactor Research Test Facility

INEEL CERCLA Disposal Facility Construction Quality Assurance Plan for Phase 2 Construction

Section I—General

1. INTRODUCTION

The U.S. Department of Energy (DOE) has tasked Bechtel BWXT Idaho, LLC (BBWI) to construct a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) disposal facility and evaporation ponds at the Idaho National Engineering and Environmental Laboratory (INEEL) near Idaho Falls, Idaho. Disposal of remediation waste, primarily contaminated soil, into the INEEL CERCLA Disposal Facility (ICDF) is scheduled to begin in 2003. This Construction Quality Assurance (CQA) Plan describes the quality assurance (QA) activities required for constructing the lining system, operation layer, and leachate collection piping of the ICDF landfill and evaporation ponds.

1.1 Purpose

During construction, QA activities shall be required to ensure that:

- Construction of the liner system, leachate collection piping, and operation layer are performed in accordance with the approved Construction Drawings, Technical Specifications (DOE 2001a), and the INEEL CERCLA Disposal Facility Remedial Design/Remedial Action (RD/RA) Work Plan (DOE-ID 2001b).
- Borrow and disturbed areas are restored in accordance with the Technical Specifications.
- Requirements of regulatory agencies related to documentation are satisfied.
- Construction of the ICDF landfill and evaporation ponds can be certified.

This CQA Plan has been prepared to describe the activities that shall be performed during construction of the lining system, leachate collection system, and operation layer of cell 1 and the evaporation ponds. Procedures invoked by this CQA Plan are intended to identify problems that may occur during construction and to document that these problems are corrected before accepting the construction.

This CQA Plan is intended to satisfy the regulatory requirements and guidance established in 40 CFR 264.19 (U.S. Environmental Protection Agency [EPA] 1994) and EPA/600/R-93-182 *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993).

This CQA Plan is intended to be implemented by an independent, third-party CQA certifying officer familiar with EPA/600/R-93-182 *Quality Assurance and Quality Control for Waste Containment Facilities* and this CQA Plan. The CQA certifying officer will be supported by the number of CQA monitors necessary to implement the requirements in this CQA Plan and document the work. BBWI will provide the number of field inspectors necessary to support the CQA monitor(s) and CQA certifying officer.

1.2 Scope

This CQA Plan establishes general administrative and documentation procedures that shall be applicable for Phase 2 construction. With respect to responsibilities, personnel qualifications, and specific inspection and testing activities, this CQA Plan addresses only those activities associated with the soils, geosynthetics, and related liner and leachate collection system piping components for the ICDF landfill and evaporation ponds. The CQA Plan is divided into sections to provide quick access to CQA requirements for individual liner components. The sections are listed below:

- Section I: General
- Section II: Soils CQA
- Section III: Geosynthetic Clay Liner CQA
- Section IV: Geomembrane CQA
- Section V: Geotextile CQA
- Section VI: Geocomposite CQA
- Section VII: Polyethylene Pipe and Fittings
- Section VIII: CQA Documentation.

1.3 Change Control Procedures

The CQA Plan and all implementing procedures are subject to the Construction Interface Document (CID) change control procedures described in subsequent sections of this CQA Plan.

1.4 Regulatory Agencies

The ICDF Complex does not require a permit. It will be an engineered facility meeting the applicable or relevant and appropriate requirements (ARARs), the remedial action objectives (RAOs), and the remedial guidelines (RGs) documented in the Idaho Nuclear Technology and Engineering Center (INTEC), Waste Area Group Operable Unit 3-13 (WAG 3) Record of Decision (ROD) (DOE-ID 1999); DOE Order 435.1, Radioactive Waste Management; Resource Conservation and Recovery Act (RCRA) Subtitle C: Idaho Hazardous Waste Management Act (HWMA); and Toxic Substances Control Act (TSCA) polychlorinated biphenyl (PCB) landfill design and construction requirements. This CQA Plan is specifically designed to support those regulatory needs.

The regulatory agencies are responsible for oversight and implementing the responsibilities identified in the Federal Facilities Agreement/Consent Order (FFA/CO) (Agreement). As provided in the Agreement, each Party to the Agreement is represented by a project manager. The project manager shall:

- Manage INEEL remedial activities including the ICDF construction for their respective agencies pursuant to the Agreement and Action Plan
- Serve as primary contacts and coordinators for their respective agencies for purposes of implementing the Agreement and Action Plan

- Prioritize work for their respective agencies
- Coordinate activities of WAG 3 project managers, who are identified by the project managers, as necessary.

2. PROJECT ORGANIZATION

This section describes the project organization for the Phase 2 ICDF construction. The following subsections address the organizations involved in the construction, their respective roles in construction activities, and the methods of interactions between organizations.

2.1 Responsibility and Authority

The QA organization chart for the ICDF construction is shown in Figure 2-1. The project organization is divided into two main groups consisting of the project team and field team. The project team consists mainly of management and will be on-site during the ICDF construction periodically to monitor progress, meetings, dispute resolutions, and as needed to ensure that the work is implemented in accordance with the Construction Drawings, Technical Specifications, RD/RA Work Plan, and agreements made with the regulatory agencies. The field team will consist of the key personnel on-site during the Phase 2 construction. The organization is based on a line and staff concept. Solid lines on the organization chart represent project responsibilities such as scope, cost, and schedule. The dashed lines represent the functional responsibilities of staff for QA, design, and health and safety. The responsibilities and reporting requirements for each project team member are described in the following sections.

2.1.1 Project Team

2.1.1.1 WAG Manager. The WAG 3 PM is responsible for all WAG 3 activities that include the ICDF construction. The WAG 3 PM serves as the primary contact and coordinator for activities performed at WAG 3 for purposes of implementing the Agreement and Action Plan and interfaces with the INTEC site area director.

2.1.1.2 INTEC Site Area Director. The INTEC site area director is responsible for the overall operation of the INTEC facility. The WAG 3 PM will keep the INTEC site area director informed of ICDF construction activities from an upper-level management perspective.

2.1.1.3 INTEC Tenant and Support Operations Manager. The INTEC tenant and support operations manager reports directly to the INTEC site area director. The ICDF project manager (ICDF PM) will interface with the INTEC tenant and support operations manager to ensure that ICDF activities are smoothly and safely integrated with ongoing INTEC activities and visa-versa.

2.1.1.4 ICDF PM. The ICDF PM will have overall responsibility for the ICDF construction and interfaces with the INTEC tenant and support operations manager and WAG 3 project engineer. The ICDF PM will direct the activities of the ICDF project and field team staff including the WAG 3 quality engineer (for ICDF activities), procurement agent, ICDF project engineer, ICDF health and safety officer (HSO), and subcontract technical representative. Additionally, the ICDF PM functions as the point of contact for the ICDF design and construction subcontractor. Functionally, the ICDF PM reviews and approves quality assurance reports submitted by the ICDF CQA certifying officer.

2.1.1.5 WAG 3 Project Engineer. The WAG 3 project engineer is responsible for providing technical support to the WAG 3 project team. The WAG 3 project engineer is supported by the ICDF project engineer for reviewing and/or preparing technical documents related to engineering design and analyses. The WAG 3 project engineer reports to the WAG 3 PM.

2.1.1.6 WAG 3 Quality Engineer. The WAG 3 quality engineer has overall responsibility for the quality control (QC) and QA of remedial activities performed at WAG 3. The WAG 3 quality engineer is responsible for the construction quality engineer and field inspection team in the field. The WAG 3 quality engineer reports quality issues related to the ICDF construction directly to the ICDF PM.

2.1.1.7 Procurement Agent. The procurement agent is responsible for all purchasing, payables, accounting, and contract administration activities including approval of contract modifications for the construction subcontractor. The CQA certifying officer contractually reports to the procurement agent. The procurement agent reports to the ICDF PM on ICDF-related procurement activities.

2.1.1.8 ICDF Design and Construction Subcontractor. The ICDF design and construction subcontractor is the design engineer of record and construction subcontractor. Functionally, the ICDF design and construction subcontractor prepares the Construction Drawings, specifications, operation and maintenance plans, design studies, construction subcontractor supplier quality control plan, and this QA plan, which are reviewed and approved by the ICDF project engineer and ICDF PM. The ICDF design and construction subcontractor is then responsible for implementing the approved design by providing the necessary labor, equipment, materials, and all other resources necessary to construct the ICDF.

2.1.1.9 ICDF Project Engineer. The ICDF project engineer is responsible for reviewing and/or preparing technical documents related to the ICDF design and construction. The ICDF project engineer reports to the ICDF PM and supports the WAG 3 project engineer.

2.1.1.10 ICDF HSO. The ICDF HSO has overall responsibility for health and safety for the ICDF project. The ICDF HSO reports to the ICDF PM and is supported by the design and construction subcontractor's safety and health officer in the field.

2.1.2 Field Team

2.1.2.1 Subcontract Technical Representative/Construction Coordinator. The Subcontract Technical Representative (STR)/construction coordinator oversees the ICDF construction activities in the field and is the on-site representative for the ICDF PM.

2.1.2.2 Construction Manager and Site Superintendent. The construction manager and superintendent represent the ICDF design and construction subcontractor and will be responsible for implementing the ICDF construction activities. The construction manager will have overall responsibility for all construction activities related to the ICDF. The superintendent will control the day-to-day construction tasks and will be the point of contact for the field personnel. The construction manager will visit the site periodically to ensure work is progressing smoothly and will be a substitute for the superintendent, if necessary. The construction manager and superintendent will be supported by the internal QC engineer and safety and health officer and will report to the STR/construction coordinator and the ICDF design and construction subcontractor's project team.

2.1.2.3 Construction Subcontractors. Construction subcontractors will include specialty companies retained by the ICDF design and construction subcontractor to perform specific work activities at the ICDF such as earth moving, geosynthetic lining installation, piping, and fence installation. The construction subcontractors will report directly to the superintendent.

2.1.2.4 Internal Construction Quality Control. The design and construction subcontractor will provide a construction QC engineer who will support the superintendent. The primary responsibility of the construction QC engineer will be to ensure that the work is performed in accordance with the Technical Specifications, Construction Drawings, and Supplier QC Plan. Specific duties of the construction QC engineer will include activities such as preparing subconstruction submittals, field documentation, and interfacing with the CQA certifying officer.

2.1.2.5 Safety and Health Officer. The safety and health officer will support the superintendent in ensuring that all work activities are performed in a safe manner and in accordance with the project-specific health and safety plan. Functionally, the safety and health officer will provide health and safety information related to the ICDF construction to the project team's ICDF HSO.

2.1.2.6 Construction Quality Engineer. The construction quality engineer reports to the WAG 3 quality engineer and STR/construction coordinator and is responsible for the field inspection team and quality assurance testing laboratory. The construction quality engineer will be responsible for providing the necessary number of qualified field inspection personnel and laboratory service for the CQA monitor and CQA certifying officer.

2.1.2.7 Field Inspection. The field inspection team reports to the construction quality engineer and will functionally support the CQA monitor and CQA certifying officer. The field inspector's function will be to perform testing and observations in accordance with this CQA Plan under the direction of the CQA monitor and CQA certifying officer.

2.1.2.8 Soils Laboratory Technicians. The laboratory technicians will report to the construction quality engineer and functionally will provide the QA testing required by this CQA Plan and as requested by the CQA monitor and CQA certifying officer.

2.1.2.9 Geosynthetic Laboratory. The geosynthetic laboratory will be selected by the CQA certifying officer and will provide the geosynthetic QA conformance testing required by this CQA Plan, as requested by the CQA monitor and/or CQA certifying officer.

The geosynthetics CQA laboratory is a testing laboratory, unaffiliated with the design engineer, materials supplier or manufacturer, or construction contractor or subcontractors. The geosynthetics CQA laboratory will have at least five years experience in testing geosynthetics and other relevant liner system components and be familiar with American Society for Testing and Materials (ASTM) and other applicable test standards. The geosynthetics CQA laboratory will be accredited by the Geosynthetics Accreditation Institute.

2.1.2.10 CQA Monitor. The CQA monitor will report directly to the CQA certifying officer and will be supported by the field inspection team and laboratory technician. The CQA monitor will ensure that all CQA tests are performed in accordance with this CQA Plan and accepted procedures and will direct the activities of the field inspection team and laboratory technician.

2.1.2.11 CQA Certifying Officer. The CQA certifying officer will be an independent third party and will have the overall responsibility of implementing this CQA Plan and shall directly supervise the CQA monitor. Functionally, the CQA certifying officer will submit CQA reports to the WAG 3 PM. The CQA certifying officer will be a registered professional engineer in Idaho and will have the authority to certify that the ICDF is constructed in accordance with the approved plans and specifications and any approved changes. An independent third party is a company retained by the CQA certifying engineer or CQA certifying engineer's representative that is a separate entity from the company performing the construction.

2.2 Project Meetings

This section includes a discussion of the various progress and status meetings that will be held throughout the ICDF construction. The purpose of the meetings is to discuss work progress, planning, and other issues related to construction. A portion of these meetings can be dedicated to CQA issues, as necessary, to provide an opportunity for the CQA team to express concerns regarding quality, to relay test results, and to ensure good communication between all organizations involved in the construction of the ICDF.

2.2.1 Pre-Construction Meeting

A pre-construction meeting will be scheduled prior to beginning major construction activities at the ICDF. At a minimum, the meeting will be attended by the ICDF PM, construction manager, STR/construction coordinator, and CQA certifying officer. A portion of the meeting will be dedicated to the discussion of QA issues. These CQA topics shall include, but not be limited to, the following:

- Reviewing the responsibilities of each organization
- Discussing the authority of agencies and project and field team members to order work stoppages
- Reviewing lines of authority and communication for each organization
- Providing each organization with all relevant CQA documents and supporting information
- Familiarizing each organization with the CQA Plan and its role relative to the design criteria, plans, and specifications
- Determining any changes to the CQA Plan that may be needed to document that the facility shall be constructed to meet or exceed the specified design requirements
- Discussing the established procedures or protocol for observations and tests, including sampling strategies
- Discussing the established procedures or protocol for handling construction deficiencies, repairs, and retesting, including "stop work" conditions
- Reviewing methods for documenting and reporting inspection data
- Reviewing methods for distributing and storing documents and reports
- Reviewing work area security and safety protocol
- Reviewing the proposed project schedule
- Discussing procedures for the location and protection of construction materials and for the prevention of damage of the materials from inclement weather or other adverse events
- Conducting a site walk-around to review construction materials and inspect equipment storage locations

- Action items, assigned actionees, and minutes shall be recorded and transmitted to the required distribution list and to meeting attendees.

2.2.2 Daily Meetings

The superintendent will conduct pre-job briefings at the work area. The participants shall include, at a minimum, the construction field personnel including lower tiered subcontractors, CQA monitor, and field inspection personnel. The primary purpose of these meetings is to address the day's planned activities and health and safety issues. Following the pre-job meeting, the CQA team will meet with the CQA monitor to discuss CQA activities planned for that day and interface needs with the construction personnel. The topics typically covered are listed below:

- Review the previous day's activities and accomplishments
- Review the work location and activities for the day (plan of the day)
- Discuss the construction subcontractor's personnel and equipment assignments for the day
- Address scheduling of resources for upcoming work
- Review any new test data
- Discuss any potential construction problems, including unexpected subsurface conditions that may jeopardize the ability to site the landfill cell or evaporation ponds according to Section 4.3.2.1
- Discuss CQA-planned activities and interface needs
- Discuss any health and safety issues.

This meeting shall be documented and the documentation shall be retained on file by a member of the CQA monitor or field inspection staff. The documentation shall be distributed to a list of individuals, to be determined at the Pre-Construction Meeting.

2.2.3 Bi-Weekly Progress Meetings

Bi-weekly meetings will be held at the site to discuss construction progress. At a minimum, the bi-weekly progress meetings shall be attended by the superintendent and/or construction manager, the STR/construction coordinator, the ICDF PM or designated alternate, and the CQA certifying officer or designated alternate. The purpose of the meeting is to:

- Review the previous week's activities and accomplishments
- Review claims, change orders, delays, and similar items
- Review planned activities for the upcoming week
- Finalize resolution of problems from the previous week
- Discuss the potential problems with the work planned for the upcoming week.

Minutes will be recorded by a party identified by the STR/construction coordinator and transmitted to the required distribution list and meeting attendees.

2.2.4 Problem or Work Deficiency Meetings

Meetings shall be convened as necessary to address CIDs, inspection deficiencies, and non-conformances. Deficiencies observed during construction by the CQA monitor and field inspection team shall be brought to the attention of the superintendent and CQA certifying officer immediately. These deficiencies will be tracked in the CQA monitor's field log book until resolution and included in the daily summary report. These documents shall include the description of the deficiency and actions taken or to be taken to resolve. If the requested corrective action is not completed to the CQA certifying officer's satisfaction, the deficiency shall be considered a non-conformance, documented on a Non Conformance Report (NCR) form, and submitted to the ICDF PM for resolution.

2.3 Hold Points

Mandatory hold points shall be established for certain key activities. At these points, the ICDF design and construction subcontractor shall cease work on the affected activity until it has been reviewed by the CQA monitor. Typical hold points would be between construction of liner system components and final operations layer placement. The schedule for hold points shall be determined when the ICDF design and construction subcontractor develops the construction schedule for the project.

3. PERSONNEL QUALIFICATIONS AND TRAINING

This section describes the qualifications and training required for CQA personnel. All documentation relating to qualifications shall be maintained with the project CQA records.

3.1 CQA Certifying Officer

The CQA certifying officer shall be employed by an independent third party and have landfill construction certification experience. The CQA certifying officer shall, at a minimum, be a registered civil professional engineer in good standing in the State of Idaho, possess a bachelor's degree in civil or construction engineering, geotechnical engineering, engineering geology, or a closely related discipline, and shall have sufficient practical, technical, and managerial experience to successfully direct the CQA activities discussed in this CQA Plan. The CQA certifying officer's qualifications shall be documented by training records and professional resume showing significant field experience in landfill construction and low permeability clay liner construction, having directed CQA activities at a minimum of five landfill construction projects or a minimum of 300 acres of combined landfill area certifying experience. Qualification documentation shall be reviewed by the ICDF PM and WAG 3 project engineer. If acceptable, a project certification form shall be completed and retained in the project QA records. Certifications shall be valid for a period of one year, after which they must be renewed.

The CQA certifying officer shall receive formal training in the requirements of the BBWI quality program, including but not limited to, documentation, receiving inspection, equipment calibration, design control, and personnel training. The CQA certifying officer shall also have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan as well as activity-specific health and safety plans.

3.2 CQA Monitor

At a minimum, a CQA monitor shall have a high school diploma and at least five years of construction-related experience, including at least three years of experience conducting CQA monitoring for earthwork construction including a minimum of three landfill construction projects or a minimum of 50 acres of combined landfill area experience, or a bachelor of science degree from a four-year college or university, and at least two years of experience conducting CQA monitoring for earthworks construction including a minimum of three landfill construction projects. The CQA monitor must be capable of performing work with little or no daily supervision and shall be a certified engineering technician in geotechnical engineering technology by the National Institute for Certification in Engineering Technologies (NICET). The CQA monitor shall have a minimum NICET Level III certification in the subfield of construction as a minimum.

Qualifications of the CQA monitor shall be documented by NICET documentation, training records, and professional resumes and shall be reviewed by the ICDF PM and CQA certifying officer, and, if acceptable, shall be certified in the same manner noted in Section 3.1 above. Certifications shall be valid for a period of one year, after which they must be renewed.

The CQA monitor shall receive formal training in the requirements of the BBWI quality program, including but not limited to, documentation, receiving inspection, equipment calibration, design control, and personnel training. The CQA monitor shall also have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan as well as activity-specific health and safety plans.

3.3 Field Inspector

At a minimum, a field inspector shall have a high school diploma and at least two years of construction-related experience, including at least one year of experience conducting CQA monitoring for earthwork construction, or a bachelor of science degree from a four-year college or university and at least six months of experience conducting field inspection for earthworks construction. The field inspector must be capable of routine engineering technician work under general daily supervision and shall be a certified engineering technician in geotechnical engineering technology by NICET. A field inspector shall have a minimum NICET Level II certification in the subfield of construction and be able to classify soils using the Unified Soil Classification System. The field inspector shall be familiar with EPA's Technical Guidance Document "*Quality Assurance and Quality Control for Waste Containment Facilities*" (EPA 1993).

Qualifications of a field inspector shall be documented by NICET documentation, training records, and professional resumes and shall be reviewed by the ICDF PM and CQA certifying officer, and, if acceptable, shall be certified in the same manner noted in Section 3.1 above. Certifications shall be valid for a period of one year, after which they must be renewed.

The field inspector shall receive formal training in the requirements of the BBWI quality program, including, but not limited to, documentation, receiving inspection, equipment calibration, design control, and personnel training. The field inspector shall also have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan as well as activity-specific health and safety plans.

3.4 Soils Laboratory Technician

At a minimum, a laboratory technician shall have a high school diploma and at least five years of construction materials laboratory testing related experience, including at least three years of experience performing geotechnical laboratory tests for earthwork construction, including compacted low permeability clay, or a bachelor of science degree from a four-year college or university and at least two years of experience performing geotechnical laboratory tests for earthwork construction, including low permeability clay. The laboratory technician must be capable of routine laboratory technician work under general daily supervision and shall be a certified engineering technician in geotechnical engineering technology by NICET, or equivalent certification as approved by the CQA certifying officer. A laboratory technician shall have a minimum NICET Level III certification, or equivalent, in the subfield of laboratory as a minimum.

Qualifications of a laboratory technician shall be documented; training records and professional resumes shall be reviewed by the ICDF PM and CQA certifying officer, and, if acceptable, shall be certified in the same manner noted in Section 3.1 above. Certifications shall be valid for a period of one year, after which they must be renewed.

A laboratory technician shall receive formal training in the requirements of the BBWI quality program, including, but not limited to, documentation, receiving inspection, equipment calibration, design control, and personnel training. The laboratory technician shall also have completed any DOE, BBWI, or other training required by BBWI's project health and safety plan, as well as activity-specific health and safety plans.

3.5 Geosynthetics Laboratory

****To be completed in subsequent submittals****

4. DEFINITIONS RELATING TO CONSTRUCTION QUALITY ASSURANCE

4.1 Construction Quality Assurance and Construction Quality Control

Construction Quality Assurance—A planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

Construction Quality Control (CQC)—Those actions that provide a means to measure and control the characteristics of an item or service to meet contractual and regulatory requirements.

4.2 Use of the Terms in This Plan

In the context of this CQA Plan the definitions provided below are used:

- CQA refers to means and actions employed by the CQA team to assure conformity of liner system preparation, production, and installation with this CQA Plan, the Technical Specifications, and the Construction Drawings. CQA is provided by a party independent from the product manufacturer and construction subcontractor.

- CQC refers to those actions taken by manufacturers, suppliers, or construction subcontractors, including their designated representatives, to ensure that the materials and the workmanship meet the requirements of the Technical Specifications and the Construction Drawings. In the case of soils, and within this CQA Plan, CQC is typically made a part of the CQA requirements and is provided by the CQA team. In the case of geosynthetic and other non-soil components, CQC is provided by the manufacturers and construction subcontractor's installers of the various geosynthetics.

5. REFERENCES

5.1 Applicable Organizations

Organizations whose standards are referenced in the CQA Plan are listed below:

- ASTM—American Society for Testing and Materials
- DOE—Department of Energy
- GRI—Geosynthetic Research Institute
- OSHA—Occupational Safety and Health Administration
- EPA—U.S. Environmental Protection Agency.

5.2 Applicable Standards

Any reference to standards of any society, institute, association, or governmental agency will pertain to the edition in effect as of the date of this CQA Plan, unless stated otherwise.

5.3 Specific Standards

Specific test standards that may be cited in the CQA Plan are shown in Table 5-1. These standards may be modified due to technological advances since compilation of Table 5-1. All such modifications are to be approved in accordance with the construction interface document procedures described in Section VIII.

TABLE 5-1. Test methods cited.

	AMERICAN SOCIETY OF TESTING AND MATERIALS	
1.	ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
2.	ASTM A726	Standard Specification for Cold-Rolled Carbon Steel Sheet, Magnetic Laminated Quality, Types 1, 2, and 2S.
3.	ASTM C88	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.
4.	ASTM C131	Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
5. or	ASTM D374C D1777	Method for Measuring Thickness of Geotextile Materials.
6.	ASTM D413	Standard Test Method for Rubber Property Adhesion to Flexible Substrate.
7.	ASTM D422	Standard Method for Particle-Size Analysis of Soils.
8.	ASTM D570	Standard Test Method for Water Absorption of Plastics.
9.	ASTM D638	Standard Test Method for Tensile Properties of Plastics.
10.	ASTM D698	Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop.
11.	ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
12.	ASTM D751	Standard Methods of Testing Coated Fabrics.

TABLE 5-1. (continued).

AMERICAN SOCIETY OF TESTING AND MATERIALS	
13. ASTM D792	Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
14. ASTM D882	Standard Test Methods for Tensile Properties of Thin Plastic Sheeting.
15. ASTM D1004	Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting.
16. ASTM D1204	Standard Plastics Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
17. ASTM D1238	Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
18. ASTM D1248	Standard Specification for Polyethylene Plastic Molding and Extrusion Metals.
19. ASTM D1505	Standard Test Methods for Density of Plastics by Density-Gradient Technique.
20. ASTM D1556	Standard Test Method for Density of Soil In Place by the Sand-Cone Method.
21. ASTM D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb_f/ft^3).
22. ASTM D1593	Standard Specification for Nonrigid Vinyl Chloride Plastic Sheeting.
23. ASTM D1603	Standard Test Method for Carbon Black in Olefin Plastics.
24. ASTM D2167	Standard Test Method for Density and Unit Weight of Soils in Place by Rubber Balloon Method.
25. ASTM D2216 or D4643	Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
26. ASTM D2434	Standard Test Method for Permeability of Granular Soils (Constant Head).
27. ASTM D2487	Standard Test Method for Classification of Soils for Engineering Purposes.
28. ASTM D2657	Standard Practice for Heat-Joining for Polyolefin Pipe and Fittings.
29. ASTM D2663	Carbon-Black Dispersion in Rubber.
30. ASTM D2837	Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
31. ASTM D2922	Standard Test Method for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth).
32. ASTM D3015	Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
33. ASTM D3017	Standard Test Method for Moisture Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth).
34. ASTM D3083	Standard Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining.
35. ASTM D3350	Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials.
36. ASTM D3776	Mass Per Unit Area (Weight) of Woven Fabric.
37. ASTM D4253	Standard Test Method for Maximum Index Testing of Soils Using a Vibratory Table.
38. ASTM D4254	Standard Test Method for Minimum Index Density of Soils and Calculations of Relative Density.
39. ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
40. ASTM D4373	Standard Test Method for Calcium Carbonate Content of Soils.
41. ASTM D4437	Standard Test Methods for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Geomembranes.
42. ASTM D4491	Standard Test Method for Water Permeability of Geotextiles by the Permittivity Method.

TABLE 5-1. (continued).

AMERICAN SOCIETY OF TESTING AND MATERIALS	
43. ASTM D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
44. ASTM D4632	Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Elongation Method and Peel Strength).
45. ASTM D4643	Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
46. ASTM D4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
47. ASTM D4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
48. ASTM D4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
49. ASTM D5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
50. ASTM D5261	Measuring Mass Per Unit Area of Geotextile.
51. ASTM D5321	Coefficient of Soil and Geosynthetics or Geosynthetics and Geosynthetics Friction by Direct Shear.
52. ASTM D5890	Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
53. ASTM D5891	Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.
54. ASTM E11	Specification for Wire-Cloth Sieves for Testing Purposes.
55. ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
56. ASTM F904	Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials.
Geosynthetic Research Institute	
1. GRI-GMI	Standard Test Method for Ductile/Brittle Transition Time for Notched Polyethylene Specimen under Constant Stress.

6. CONSTRUCTION ACTIVITIES AND SUBMITTAL REQUIREMENTS

6.1 Construction Activities

This section describes the construction activities and submittal requirements that shall be performed by the construction subcontractor during the ICDF construction. This CQA Plan only addresses the Phase 2 portion of the ICDF construction, which is planned for the 2002 summer construction season. Phase 1 construction was completed under a separate CQA Plan in the 2001 summer construction season and consisted of the activities listed below.

- Approving work order
- Mobilizing construction equipment and personnel
- Vendor data submittals
- Installing sediment and erosion control
- Constructing haul roads
- Mobilizing equipment for test pad
- Clearing, grubbing, and stripping
- Preparing stockpile area subgrade
- Excavating ICDF landfill cell 1
- Constructing test pad
- Constructing evaporation ponds pad embankments
- Restoring site
- Demobilizing.

In general, Phase 2 construction activities will consist of installing the liner system, LDRS, LCRS, and operations layer and necessary equipment to complete the landfill and evaporation pond for waste acceptance.

****To be completed in subsequent submittals****

Prior to the start of construction activities, the CQA certifying officer, CQA monitor, and field inspectors shall review and become familiar with the RD/RA Work Plan including all Construction Drawings and Technical Specifications. The CQA certifying officer should also be familiar with the most recent construction schedule so that adequate resources (i.e., laboratory, field testing equipment, staff, and CQA forms) including contingencies (e.g., backup equipment, alternate laboratory, and alternate CQA staff) for CQA activities will be commensurate with the anticipated construction productivity and work schedule. All necessary measures should be taken to avoid delaying construction activities and the completion of the ICDF.

6.2 Submittal Requirements

The construction subcontractor will provide the CQA monitor with QC test results and a written certification signed by a responsible party of the supplier that the tests required by the Technical Specifications have been performed on the material to be delivered to the site.

The CQA monitor will examine the tests results and report any deviations to the ICDF PM. If the construction subcontractor cannot provide test results required by the Technical Specifications, the CQA monitor may perform or arrange to perform the tests. The required submittals are listed in Table 6-1, which will be completed in subsequent submittals.

****To be completed in subsequent submittals****

SECTION II—SOILS CONSTRUCTION QUALITY ASSURANCE

1. INTRODUCTION

Section II of the CQA Plan addresses the soils components of the liner systems and specifies the soils CQA program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and corrective action requirements.

2. EXCAVATED SUBGRADE

2.1 Verification of Subgrade Continuity

When the excavation of the landfill or evaporation ponds is completed, the CQA monitor will:

- Inspect the subgrade on the side slopes and base of the landfill or evaporation ponds and note areas of weak or excessively weathered subgrade materials
- Observe the proof rolling of the base of the landfill or evaporation ponds and note areas that exhibit excessive rutting, heaving, or softening.

Backfill material in the excavation will be structural fill or clay liner material that will be placed and compacted. The CQA monitor will observe any excavation and backfilling operations.

2.2 Structural Fill Placement and Compaction

The Technical Specifications will be followed for the placement and compaction of structural fill. The CQA monitor will monitor the fill placement and compaction to verify and document the following:

- The soil being placed meets the Technical Specifications requirements for fill as determined by the test methods and frequencies specified within this CQA Plan
- The compacted lift thickness is in accordance with the requirements of the Technical Specifications
- The previous lift is scarified as specified in the Technical Specifications before placing the next lift
- Fill is moisture conditioned, as required in the Technical Specifications
- The compacted moisture content and dry unit weight of the fill meets specifications as determined by the test methods and frequencies described below.

2.3 Construction Quality Assurance Evaluation

The minimum frequency of soils testing for CQA purposes will conform to the minimum frequencies presented in Table II-1.

Nuclear density meter test methods will be used for the field testing of the in situ dry unit weight and moisture content of the in-place, compacted fill. Standard Count Calibration and oven moisture content tests will be conducted to calibrate the results of the nuclear density meter and, in cases of uncertainty, with the nuclear density meter test results. All perforations in the fill will be backfilled in accordance with the Technical Specifications.

If an in-place density test result fails to meet specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, the CQA monitor will determine the extent and nature of the defect by

observations and/or additional testing as necessary to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the fill, the CQA monitor will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA monitor will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA monitor deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA monitor will define the limits and nature of the defect by testing or observation.

2.4 Surveying

A professional land surveyor registered in the State of Idaho will perform the CQA survey. The CQA surveyor will independently survey the excavation to confirm that the grades and elevations in the field agree with those shown in the Construction Drawings. CQA surveys will be conducted in accordance with the requirements described in Part 6 of Section II.

The results of the survey conducted by the CQA surveyor will be compiled in a report signed by the CQA surveyor and the CQA certifying engineer. The CQA certifying engineer will review and approve the survey results before the next phase of the lining system is constructed.

3. PREPARED SUBGRADE

3.1 Prepared Subgrade Placement and Compaction

The CQA Team will verify and document that the prepared subgrade is constructed to the elevations, grades, and thicknesses shown in the Construction Drawings, with material meeting the requirements of the Technical Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the prepared subgrade, the CQA Team will verify and document that:

- All or an approved portion of the excavation is complete, and that a survey has been conducted to verify that the subgrade grades and elevations conform to the Construction Drawings
- The subgrade meets specifications as determined by the test requirements of this CQA Plan
- The surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice, or frozen material
- If frozen subgrade material is encountered, it is removed and replaced in accordance with the Technical Specifications.
- During placement and compaction of the prepared subgrade, the CQA Team will verify and document that:
- Close inspection of the placement and compaction of the prepared subgrade with earthmoving equipment is performed by the CQA monitors and field inspectors
- The prepared subgrade material meets the requirements of the Technical Specifications as determined by the CQA testing methods and frequency in Table II-2
- The prepared subgrade is placed in accordance with the conditions and minimum requirements of the Technical Specifications
- Each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the Technical Specifications as determined by the CQA testing methods and frequency in Table II-2
- The construction subcontractor uses the compaction equipment and the minimum number of passes between lifts specified in the Technical Specifications
- Perforations in the prepared subgrade at testing and sampling locations are backfilled in accordance with the Technical Specifications
- The CQA Team will document the properties of the prepared subgrade as determined by the test methods and frequency prescribed by this CQA Plan and will report any non conformance with the Technical Specifications in accordance with the non conformance reporting procedures described in Section VIII.

3.2 Construction Quality Assurance Evaluation

Construction quality assurance testing is required of the prepared subgrade. Nuclear density meter test methods will be used for testing the in situ compacted dry unit weight and moisture content of the materials. Standard Count Calibration and oven moisture content tests will be used to calibrate the reading of the nuclear density meter and, in cases of uncertainty, with the nuclear density meter readings. Any discrepancies between test results will be resolved by the CQA certifying engineer. The CQA monitor and field inspectors will conduct moisture and density tests as specified in Table II-2.

The testing frequency during prepared subgrade construction may be increased or modified at the discretion of the CQA field monitor or field inspector when visual observations of construction performance indicate potential problems.

During construction, the frequency of testing may be increased by the CQA field monitor or field inspector during adverse weather conditions, if equipment breaks down, at the start and finish of grading, if the material fails to meet the requirements of the Technical Specifications, or the extent of the work area is reduced.

If an in-place density test result fails to meet specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, additional testing will be performed to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the prepared subgrade, the CQA monitor or field inspector will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA monitor or field inspector will determine the extent of the defective area by additional tests, observations, a review of records, or other means that he/she deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA monitor or field inspector will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and has been remedied by the construction subcontractor, the CQA monitor or field inspector will verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the construction subcontractor in the area of the deficiency.

Based on the requirements of the Technical Specifications, the construction subcontractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction subcontractor will be required to immediately make all repairs and replacements necessary. The CQA team will verify and document that all damages are repaired.

3.3 Surveying

A professional land surveyor registered in the State of Idaho will perform the CQA surveys. The CQA surveyor will independently survey the elevations and grades of the prepared subgrade surfaces to confirm that the lines and elevations in the field agree with those shown in the Construction Drawings. CQA surveys will be conducted in accordance with the requirements described in Part 6 of Section II.

The results of the survey conducted by the CQA surveyor will be compiled in a report signed by the CQA surveyor and the CQA certifying engineer, and will be reviewed by the ICDF PM, ICDF PE,

and the CQA certifying engineer will approve the survey results before the next component of the liner system is constructed.

4. COMPACTED CLAY LINER AND TEST PAD

The compacted clay liner (CCL) is composed of a preselected base soil and bentonite material admix and is herein referred to as the CCL. A CCL test pad was constructed during Phase 1 construction to determine the specific construction methods and CQA testing procedures for the clay liner in the ICDF landfill. Since the Phase 1 test pad was constructed prior to excavating the ICDF cell 1, it was constructed on a level surface. The second test pad will be constructed on a sloping surface during Phase 2 to verify that compaction methods determined during Phase 1 will be adequate for the side slopes of the landfill. The results of the Phase 1 test pad are provided in the Test Pad Post-Construction Report and have been incorporated in the Technical Specifications and this CQA Plan. If necessary, the Technical Specifications and/or CQA Plan may be modified based on the results of the Phase 2 test pad in accordance with construction interface procedures.

4.1 Test Pad

****To be completed in subsequent submittals****

4.2 Compacted Clay Liner

The CQA Team will verify and document that the clay liner is placed to the elevations, grades, and thicknesses shown in the Construction Drawings, with bentonite-amended material meeting the requirements of the Technical Specifications as determined by the test methods and frequencies specified within this CQA Plan.

4.2.1 Construction Quality Assurance Evaluation

Extensive CQA testing, observation, and data collected during the CCL test pads is required for the CCL. CQA testing will be performed during preprocessing and placement of the CCL. The CQA team will conduct the preprocessing and placement tests specified in Table II-3. The maximum allowable percentage of failing tests is specified in Table II-4.

4.2.1.1 Preprocessing. Prior to amending the base soil with bentonite, the CQA monitor will verify and document that:

- Equipment and methods are the same or equivalent as determined from the test pad studies.
- All submittals have been reviewed and approved.
- The base soil borrow source area has been approved by the design engineer, ICDF PM or ICDF PE.
- The mixing area is suitable for amending bentonite with base soils and meets the requirements in the Technical Specifications.
- Lift thickness control meets the requirements in the Technical Specifications.

During preprocessing, the CQA Team will verify and document that:

- The bentonite is in conformance with the Technical Specifications

- Close observation of the base soil excavation and preprocessing with earthmoving equipment is performed by the field inspector
- The preprocessed clay liner material meets the requirements of the Technical Specifications as determined by the CQA testing methods and frequency in Table II-3
- The moisture content and consistency of base soil allow the bentonite to be mixed uniformly
- Bentonite amendments are mixed uniformly with the base soil
- The bentonite is mixed with the base soil during dry weather conditions
- The preprocessed clay liner material is stored, protected, and allowed to cure in accordance with the conditions and minimum requirements of the Technical Specifications
- The bentonite is mixed at the required application rate and thickness established by the Specifications as determined by the CQA testing methods and frequency in Table II-3.

The CQA monitor will document the properties of the preprocessed compacted clay material as determined by the test methods and frequency prescribed by this CQA Plan and will report any non conformance with the Technical Specifications in accordance with the non conformance reporting procedures described in Section VIII.

The field inspector will observe preprocessing activities including base soil excavation, bentonite blending, and moisture conditioning. Test methods for verifying the bentonite application rate developed during the test pad construction will be used to determine the quantity of bentonite added to the base soils.

The field inspector will monitor the excavation of base soil from the approved borrow source. Deleterious base soil or base soil not meeting the Technical Specifications shall be identified and reported to the certifying engineer and not allowed in the preprocessing area.

CQA tests will be performed on the raw bentonite used in the CCL to verify conformance to the Technical Specifications. The CQA monitor will collect samples of raw bentonite delivered to the site for testing in the on-site laboratory. The CQA laboratory technician will conduct liquid limit, free swell, and grain size tests of the bentonite in accordance with Table II-3. If the test results of a sample fail to meet specifications, a confirmatory test will be performed immediately subsequent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed from the same bentonite load. If the second confirmatory test also meets or exceeds specifications, the bentonite load will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, the load will be rejected and removed from the site.

Test methods for verifying the bentonite application rate developed during the test pad construction will be used to determine the quantity of bentonite added to the base soils. The field inspector will observe mixing and test the bentonite-amended soil prior to placing it in the ICDF landfill.

4.2.2 Placement

Prior to the placement of the CCL, the CQA Team will verify and document that:

- The Phase 2 test pad has been constructed with the proposed liner material and production scale equipment to confirm compaction procedures on a 3H:1V slope. In addition, field testing shall be completed on the test pad to confirm clay liner placement specifications will be achieved on the sloped portions of the ICDF landfill.

- All or an approved portion of the excavation are complete, and that a survey has been conducted to verify that the subgrade grades and elevations conform to the Construction Drawings.

- The prepared subgrade meets specifications as determined by the test requirements of this CQA Plan.

- The surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice, or frozen material.

- If frozen subgrade material is encountered, it is removed and replaced in accordance with the Technical Specifications.

- The CCL material is free of roots, stumps, vegetation, or any other type of deleterious material that may impact the performance of the placed clay liner.

- The CCL material does not contain stones or clods with dimensions in excess of those required by the Technical Specifications.

- The CCL material meets or exceeds the requirements of the Technical Specifications as determined by the CQA testing methods and frequency in Table II-3.

- The moisture content of the CCL material is uniform.

During placement and compaction of the clay liner, the CQA Team will verify and document that:

- Close observation of the placement and compaction of clay liner material with earthmoving equipment is performed by the field inspectors

- The CCL material meets the requirements of the Technical Specifications as determined by the CQA testing methods and frequency in Table II-3 and maximum allowable failure rates in Table II-4

- The CCL is placed in accordance with the conditions and minimum requirements of the Technical Specifications

- Each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the Technical Specifications as determined by the CQA testing methods and frequency in Table II-3

- The construction subcontractor uses the compaction equipment and the number of passes specified in the Technical Specifications

- Shelby tube samples are collected for laboratory permeability testing at the frequency specified in Table II-3

- Perforations in the clay liner at testing and sampling locations are repaired in accordance with the Technical Specifications.

The CQA Team will document the properties of the CCL as determined by the test methods and frequency prescribed by this CQA Plan and will report any non conformance in accordance with the non conformance reporting described in Section VIII.

The field inspector will collect samples immediately after a loose lift of clay liner materials has been placed for property tests prior to compaction. The on-site soil laboratory will determine index properties including percent fines, percent gravel, liquid and plastic limits, and compaction curve from samples collected from the clay liner as specified in Table II-3. Results from the tests will be available within 24 hours after sampling. The number of failing tests shall be less than the maximum percentage of failing tests specified in Table II-3. If the failing tests exceed the maximum percentage of failing tests or are concentrated in one lift or one area, the CQA monitor shall delineate the failing area for reprocessing. Reprocessing may be performed in situ in the preprocessing area.

Once compacted, nuclear density meter test methods will be used for testing the in situ compacted dry unit weight and moisture content of the clay liner. Standard Count Calibration and moisture content tests will be used to calibrate the reading of the nuclear density meter and, in cases of uncertainty, with the nuclear density meter readings. The CQA monitor will collect Shelby tube samples of the CCL for laboratory permeability tests as specified in Table II-3.

If in-place density test results fail to meet specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications, the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, additional testing will be performed to identify the limits of the area that does not meet project specifications.

Rapid laboratory permeability tests such as the flow pump method (Daniel and Koerner 1995) and constant volume tests will be used to determine permeability. Once the sample has achieved the specified permeability, the test result will be reported immediately to the CQA certifying engineer. The number of failing tests shall be less than the maximum percentage of failing tests specified in Table II-4.

The testing frequency during the CCL construction may be increased or modified at the discretion of the CQA certifying engineer when visual observations of construction performance indicate potential problems or when field experience with the proposed CCL material have been obtained.

During construction, the frequency of testing may be increased by the CQA certifying engineer during adverse weather conditions, if equipment breaks down, at the start and finish of grading, if the material fails to meet the requirements of the Technical Specifications, or the extent of the work area is reduced.

All perforations in the clay liner at nuclear density test probe locations will be repaired by the CQA Team in accordance using the method recommended in the Test Pad Post-Construction Report.

If a defective area is discovered in the clay liner, the CQA monitor will determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA monitor will determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA monitor deems appropriate. If the defect is related to adverse site conditions, such as

excessively wet soils or surface desiccation, the CQA monitor will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and has been remedied by the construction subcontractor, the CQA monitor will verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the construction subcontractor in the area of the deficiency.

Based on the requirements of the Technical Specifications, the construction subcontractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction subcontractor will be required to immediately make all repairs and replacements necessary. The CQA Team will verify and document that all damages are repaired.

4.2.3 Surveying

A professional land surveyor registered in the State of Idaho will perform the CQA surveys. The CQA surveyor will independently survey the elevations and grades of the clay liner surfaces to confirm that the lines and elevations in the field agree with those shown in the Construction Drawings. CQA surveys will be conducted in accordance with the requirements described in Part 6 of Section II.

The results of the survey conducted by the CQA surveyor will be compiled in a report signed by the CQA surveyor and the CQA certifying engineer. The CQA certifying engineer will approve the survey results before the next component of the liner system (geomembrane installation) is constructed.

5. GRAVEL

5.1 Conformance Evaluation

The test methods and frequency for CQA conformance testing of the leachate collection recovery system (LCRS) and leak detection recovery system (LDRS) gravels are specified in Table II-5.

If the material fails to meet the requirements of the Technical Specifications, the CQA Team will perform sufficient sampling and testing to identify the extent of the nonconforming material. Nonconforming material will be removed from the site.

5.2 Placement and Compaction

The CQA Team will verify and document that the gravel is constructed to the elevations, grades, and thicknesses shown in the Construction Drawings, with material meeting the requirements of the Technical Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the gravel, the CQA monitor and field inspectors will verify and document that:

- The underlying geosynthetic layers are free of holes, tears, excessive wrinkles, or foreign objects
- All work on underlying layers is complete and accepted by the CQA certifying engineer.

During placement and compaction of the gravel, the CQA monitor and field inspectors will verify and document that:

- Gravel material satisfies the requirements of the Technical Specifications as determined by the testing prescribed within the CQA Plan
- Gravel material is non-angular and free of material that could damage the underlying liner materials
- Gravel material is spread during cooler portions of the day, unless otherwise approved by the CQA certifying engineer
- The equipment wheel ground pressure versus the material thickness are in compliance with requirements given in the Technical Specifications
- The gravel is placed in a manner so that the maximum material drop height is in accordance with the Technical Specifications
- Close observation of the placement and compaction of gravel with earth moving equipment is performed
- The gravel is compacted utilizing the equipment and number of passes specified in the Technical Specifications.

5.3 Construction Quality Assurance Evaluation

No density tests will be conducted on the gravel. If the CQA monitor or field inspector suspects damage to pipes or underlying geosynthetic, the construction subcontractor will be required to expose the potentially damaged materials and repair any observed damage.

5.4 Surveying

A professional land surveyor registered in the State of Idaho will perform CQA surveys. The CQA surveyor will independently survey the elevations and grades of the top of the gravel, to confirm that the grades and elevations in the field agree with those shown in the Construction Drawings. The CQA surveys will be performed in accordance with the requirements described in Part 6 of Section II.

The results of the survey conducted by the CQA surveyor will be compiled in a report signed by the CQA surveyor and the CQA certifying engineer. The CQA certifying engineer will approve the survey results before the next phase of the lining system is constructed.

6. OPERATIONS LAYER

The CQA Team will verify and document that the operations layer is constructed to the elevations, grades, and thicknesses shown in the Construction Drawings, with material meeting the requirements of the Technical Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the operations layer, the CQA Team will verify and document that:

- The underlying geosynthetic layer is free of holes, tears, excessive wrinkles, or foreign objects
- All work on underlying layers is complete and accepted by the CQA Certifying Officer.
- During placement of the operations layer, the CQA monitor and field inspectors will verify and document that:
- The soil is suitable and satisfies the requirements of the Technical Specifications as determined by the test methods and frequencies prescribed in Table II-6
- The operations soil is placed in accordance with the Technical Specifications
- The lift thicknesses and total thickness of the operations layer agree with the requirements of the Technical Specifications
- If excessive wrinkles begin to develop in the underlying geosynthetics during material placement or spreading, the wrinkles are worked out prior to continued placement operations
- The operations layer is lightly compacted as described in the Technical Specifications
- The operations layer is placed on the side slopes to the limits shown in the Construction Drawings
- No operations layer material is placed or compacted during periods of unfavorable weather conditions.

6.1 Conformance Evaluation

The test methods and frequencies for CQA conformance testing for the operations layer are specified in Table II-6.

If damage to underlying geosynthetics is expected, the CQA monitor will require that the overlying operations layer material be removed to expose the geosynthetics.

The construction subcontractor will be required to use all means necessary to protect all prior work, as well as all materials and completed work of other sections. In the event of damage, the construction subcontractor will be required to immediately make all repairs and replacements necessary. The CQA monitor and field inspectors will verify and document that all damages are repaired.

6.2 Surveying

A professional land surveyor registered in the State of Idaho will perform the CQA surveys. The CQA surveyor will independently survey the elevations and grades of the top of the operations layer on the base and side slopes of the landfill, to confirm that the grades and elevations in the field agree with those shown in the Construction Drawings. The CQA surveys will be performed in accordance with the requirements described in Part 6 of Section II. The results of the survey conducted by the CQA surveyor will be compiled in a report signed by the CQA surveyor and the CQA certifying engineer.

The surveyor will be required to survey each soil layer of the liner system for the ICDF landfill and evaporation ponds in accordance with the requirements of the Technical Specifications. A Record Drawing will be submitted to the CQA certifying engineer by the surveyor before the placement of the next liner system layer. The surveys will be conducted at a 100-ft grid for slopes greater than 25% and at a 50-ft grid for slopes less than 25%. The CQA survey will include enough information to confirm that the following features of the landfill and evaporation ponds are constructed in accordance with the Construction Drawings:

- Toe of slope
- Crest of slope
- Grade breaks
- Anchor trench
- LDRS and LCRS sumps
- Perimeter drainage ditches.

The CQA certifying engineer will approve the survey prior to proceeding with subsequent liner components.

TABLE II-1. Minimum frequency of testing for CQA evaluation of structural fill.

Test	Frequency	Standard Test Method
Pre-Placement		
Modified proctor	1 per 5,000 yd^3 (minimum 1 per source)	ASTM D1557
Sieve analysis	1 per 5,000 yd^3 (minimum 1 per source)	ASTM D422
Atterberg limits	1 per 5,000 yd^3 (minimum 1 per source)	ASTM D4318
Placement		
in situ moisture content	1 per 10,000 ft^2 per lift	ASTM D3017
in situ dry unit weight	1 per 10,000 ft^2 per lift	ASTM D2922
Standard count calibration or sandcone	1 per day of fill placement	ASTM D1556/D2922
Oven moisture contents (in situ moisture content)	1 per day of fill placement	ASTM D2216

TABLE II-2. Minimum frequency of testing for CQA evaluation of prepared subgrade.

Test	Frequency	Standard Test Method
in situ moisture content	1 per 8,000 ft^2 per lift	ASTM D3017
in situ dry unit weight	1 per 8,000 ft^2 per lift	ASTM D2922
Standard count calibration or sand cone (in situ density)	1 per day of fill placement	ASTM D1556
Oven moisture content (in situ moisture content)	1 per 10 in situ tests	ASTM D2216
Modified proctor	1 per 250,000 ft^2	ASTM D1557
Sieve analysis	1 per 125,000 ft^2	ASTM D422
Atterberg limits	1 per 125,000 ft^2	ASTM D4318

TABLE II-3. Minimum Frequency of testing for CQA evaluation of clay liner.

Test	Frequency	Standard Test Method
Bentonite		
Liquid limit	1 per truckload	ASTM D4218
Free swell	1 per truckload	a
Grain size	1 per truckload	ASTM D422
Preprocessing		
Base soil excavation	Continuous	Observation
Base soil moisture content	1 per day of mixing	ASTM D2216
Bentonite application	Continuous	Observation
Bentonite application rate	**to be determined in the subsequent submittal**	b
Curing [c]	1 per 24 hours	Observation
Pre-Compaction[d]		
Lift thickness	1 per 2,500 ft^2 per lift	Field Measurement
Percent fines	1 per 500 yd^3 or 1 per day of placement minimum	ASTM D1140
Percent gravel	1 per 500 yd^3 or 1 per day of placement minimum	ASTM D422
Compaction curves	1 per 2500 yd^3 (minimum 1 per source)	e
Placement	Continuous	Observation
Post Compaction		
Rapid moisture content	5 per acre per lift or 1 per day of compaction minimum[f]	ASTM D3017
Rapid dry unit weight	5 per acre per lift or 1 per day of compaction minimum	ASTM D2922
Oven moisture content	1 per 10 rapid moisture content	ASTM D2216
Density gauge calibration	2 per day minimum	ASTM D2216
Shelby tube samples	1 per acre per lift	ASTM D1587 ASTM D5084[g,h]
Number of passes[i]	1 per acre per lift	Observation
Construction Oversight	Continuous	Observation

a. The test method is based on the bentonite manufacturers' recommendation.

b. The test method for determining the application rate of bentonite was determined by the Phase 2 test pad construction.

c. Curing is stockpiling the Soil Bentonite Liner material for 12 hours to allow the bentonite to hydrate.

d. The frequency of pre-compaction tests have been doubled assuming that bentonite mixing will be performed by earth-moving equipment similar to that used for the test pad constructed in August, 2001.

e. The compaction curve will be determined to check the acceptable zone of dry unit weight and moisture content determined during the soil amendment study (DOE-ID 2001c) and test pad construction using the procedure recommended by Daniel and Benson (1990).

f. A loose lift is 9 in. thick.

g. The effective confining stress shall be 5 psi.

h. Rapid tests should be used with results reported immediately once the specified permeability is reached.

i A single pass is defined as forward and back.

TABLE II-4. Maximum percentage of failed tests for CQA evaluation of clay liner.

Test	
Percent fines	5% and outliers not concentrated in one lift or one area
Percent gravel	5% and outliers not concentrated in one lift or one area
Clod size	10% and outliers not concentrated in one lift or one area
Rapid moisture content	3% and outliers not concentrated in one lift or one area, and no water content less than 2% or more than 3% of the specified value
Rapid dry unit weight	3% and outliers not concentrated in one lift or one area, and no dry unit weight less than 5 pcf below the specified value
Shelby tube samples (laboratory permeability)	5% and outliers not concentrated in one lift or one area

TABLE II-5. Minimum frequency of testing for CQA evaluation of gravel.

Test	Frequency	Standard Test Method
Pre-Placement		
Sieve analysis	1 per 2,500 yd^3	ASTM D422
Permeability	1 per 2,500 yd^3	ASTM D2434
Carbonate content	1 per 2,500 yd^3 (if material does not have significant carbonate, reduce to 1 per 25,000 yd^3)	ASTM D4373
Placement		
Sieve analysis	1 per 500 yd^3 (minimum 1 per source)	ASTM D422
Permeability	1 per 500 yd^3 (minimum 1 per source)	ASTM D2434

TABLE II-6. Minimum frequency of testing for CQA evaluation of operations layer.

Test	Frequency	Standard Test Method
Pre-Placement		
Sieve analysis	1 per 5,000 yd^3 placed (minimum 1 per source)	ASTM D422
Placement		
Sieve analysis	1 per 2,000 yd^3	ASTM D422